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**A Quarterly Bulletin of the Pacific El Niño/Southern Oscillation Applications Climate (PEAC) Center
Providing Information on Climate Variability for the U.S.-Affiliated Pacific Islands**

<http://www.prh.noaa.gov/peac>

CURRENT CONDITIONS

According to the U.S. Climate Prediction Center (CPC), La Niña conditions continued through October in the tropical Pacific. Oceanic and atmospheric indices of ENSO are now indicative that a moderate to strong La Niña is underway. La Niña conditions are anticipated to last at least through the next northern spring. Weather patterns during the past 6 months were clearly that of La Niña: strong and persistent, easterly, low-level wind flow across Micronesia, and monsoon and tropical cyclone activity pushed to the northwest of normal with elevated sea level. Tropical cyclone activity in the western North Pacific is at historical lows, with only 15 numbered tropical cyclones through mid-October. A sharp reduction of tropical cyclone activity is typical during a year that follows an El Niño, but this year's reduction is unprecedented, and continues a multi-year run of quiescence across the entire tropical Pacific.

Rainfall has been near normal across most of Micronesia (see Figures 1a and 1b on page 2). The lack of the monsoon trough and westward displacement of tropical cyclones have resulted in an extended period of "tranquil" weather (i.e., few notable extremes of heavy rain). The current La Niña event has seen a strong westward extension of the equatorial tongue of cold water. Because of this, atolls near the equator (e.g., Kapingamarangi, Nauru, and western Kiribati) have become very dry. As part of Pohnpei State, the island of Kapingamarangi has received drought advisories from the Weather Forecast Office (WFO) Guam and its home Weather Service Office (WSO) on Pohnpei Island. Equatorial dryness has recently edged northward to Nukuoro (~4°N) and Kosrae (~6°N), but overall, these locations have received ample rainfall. The Hawaiian Islands remain very dry, with extreme drought conditions on large portions of the Big Island, eastern Oahu, Kauai, western Molokai, Lanai, and Maui.

Near to above normal rainfall is anticipated throughout much of Micronesia during the next three to six months, with the exception of Kapingamarangi, where dry conditions will continue for the next few months. American Samoa is entering its rainy season, and abundant rains are expected there. Most locations in Hawaii will soon enter their winter rainy season, and things look to continue on the dry side. When seasonal rains return to Micronesia next spring (e.g., April to June at Pohnpei Island), there is the possibility of above normal rainfall. When climate indices show a strong La Niña at the beginning of the year, and then

steadily fall toward ENSO-neutral or El Niño conditions, Micronesia tends to experience very wet conditions during the first 6 months of the year. During such years, the trade wind trough (the band of heavy rain showers where the NE trades and the SE trades converge) is active and persistent across Micronesia. During January and February, Abundant rain showers are confined first to locations between 3°N to 6°N. Later in the northern spring (April and May), the trade wind trough progresses northward to bring abundant rainfall to locations up to 8°N, which includes Pohnpei Island, Chuuk Lagoon and the Mortlock Islands, and Palau. Islands north of 10°N have their greatest chance for above normal rainfall in the first half of the year primarily when the climate state is transitioning from La Niña or ENSO-neutral to El Niño.

The following comments from the 07 October 2010 **EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION**, were posted on the U.S. Climate Prediction Center web site:

"ENSO Alert System Status: La Niña Advisory

Synopsis: La Niña is expected to last at least into the Northern Hemisphere spring 2011.

Consistent with nearly all of the forecast models, La Niña is expected to last at least into the Northern Hemisphere spring 2011. Just over half of the models, as well as the dynamical and statistical averages, predict La Niña to become a strong episode (defined by a 3-month average Niño-3.4 index of -1.5°C or colder) by the November-January season before beginning to weaken. Even though the rate of anomalous cooling temporarily abated during September, this model outcome is favored due to the historical tendency for La Niña to strengthen as winter approaches...

Likely La Niña impacts during October-December 2010 include suppressed convection over the central tropical Pacific Ocean, and enhanced convection over Indonesia. The transition into the Northern Hemisphere fall means that La Niña will begin to exert an increasing influence on the weather and climate of the United States. Also, La Niña can contribute to increased Atlantic hurricane activity by decreasing the vertical wind shear over the Caribbean Sea and tropical Atlantic Ocean. Conversely, La Niña is associated with suppressed hurricane activity across the central and eastern tropical North Pacific."

SEA SURFACE TEMPERATURES

La Niña continued during September 2010 as reflected by the large expanse of below-average sea surface temperatures (SSTs) across most of the equatorial Pacific Ocean. All weekly Niño SST index values were between -1.3°C and -1.8°C at the end of the month. In addition, the subsurface heat content (average temperatures in the upper 300m of the ocean) remained below-average, reflecting a shallower-than-average thermocline in the central and eastern Pacific. Convection remained enhanced over Indonesia and suppressed over the western and central equatorial Pacific. This pattern was linked to a continuation of enhanced low-level easterly trade winds and anomalous upper-level westerly winds over the western and central equatorial Pacific. These oceanic and atmospheric anomalies reflect the ongoing La Niña.

SOUTHERN OSCILLATION INDEX

The 3-month average of the Southern Oscillation Index for the 4th Quarter of 2010 was +2.1, with monthly values of +2.0, +1.7 and +2.6 for the months of July, August, and September 2010, respectively. These recent positive SOI values, in addition to negative sea surface temperature readings, indicate the presence of moderate to strong La Niña conditions in the tropical Pacific Ocean.

Normally, positive SOI values in excess of +1.0 are associated with La Niña conditions, and negative SOI values below -1.0 are associated with El Niño conditions. Low SOI values suggest a weak coupling between the ocean and the atmosphere. The SOI is an index representing the normalized sea-level pressure difference between Darwin, Australia and Tahiti, respectively.

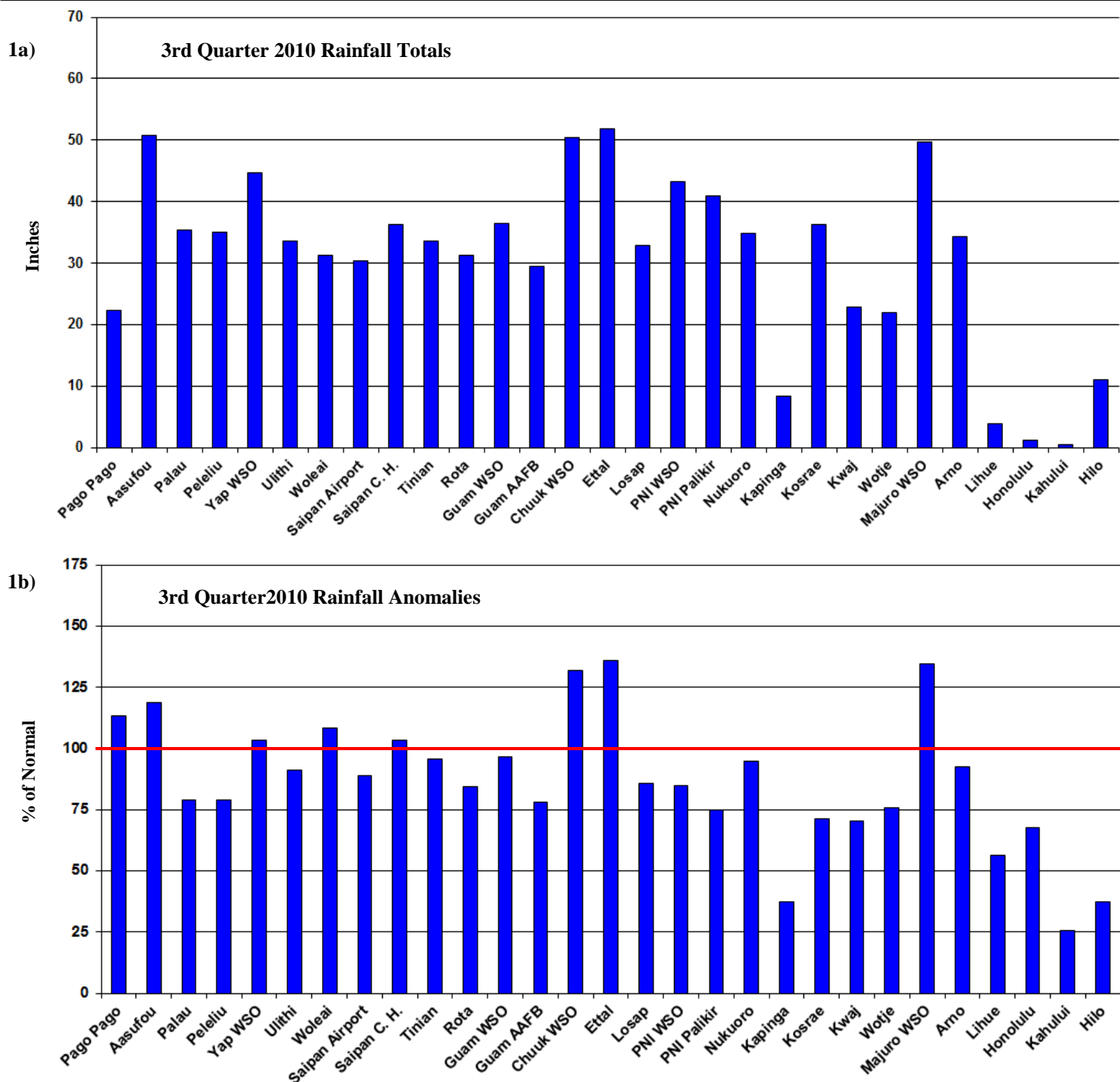


Figure 1, above. 3rd Quarter 2010 rainfall totals (a) in inches and (b) anomalies (expressed as % of normal).

TROPICAL CYCLONE

The PEAC archives western North Pacific tropical cyclone numbers, track coordinates, and 1-minute average maximum sustained wind taken from operational warnings issued by the Joint Typhoon Warning Center (JTWC) of the U. S. Air Force and Navy, located at Pearl Harbor, Hawai'i. Western North Pacific tropical cyclone names are obtained from warnings issued by the Japan Meteorological Agency (JMA), which is the World Meteorological Organization's Regional Specialized Meteorological Center (RSMC) for the western North Pacific basin. The PEAC archives South Pacific tropical cyclone names, track coordinates, central pressure, and 10-minute average maximum sustained wind estimates from advisories issued by the Tropical Cyclone Warning Centers at Brisbane, Nadi, and Wellington. The numbering scheme and the 1-minute average maximum sustained wind estimates are taken from warnings issued by the JTWC. There are sometimes differences in the statistics (e.g., storm maximum intensity) for a given tropical cyclone among the agencies that are noted in this summary.

Tropical Cyclone Summary

In contrast to a very active Atlantic, the tropical cyclone activity across the Pacific basin was substantially reduced during 2010. The TC activity in the western North Pacific basin has been flirting all year with record low values. By mid-October, the JTWC had numbered only 15 tropical cyclones. Cyclone number 15 (Super typhoon Megi) was given its number by the JTWC on the morning of 13 October 2010. This was the latest in the records of the JTWC for the formation of the 15th TC of the year. Through 15 October 2010, the JTWC numbered 15 tropical cyclones with the following distribution: seven typhoons, six tropical storms, and two tropical depressions. This is far below normal in all categories. The following experimental forecast for the annual total of western North Pacific TC activity was issued by Paul Stanko (Senior forecaster, Guam WFO) on 10 October 2010:

"The regression forecast [for the 2010 annual total] has slipped to 22 (was 23 in mid-September). This is in the Far Below Normal quintile, and only 1 above the record low. It is also the lowest my forecast has ever issued on this date in all the 52 years of data.

Climatology is 31, so this is 71% of normal, or about 1.7 standard deviations below normal. The R2 value is 0.82 for the regression on this date. Using the training set as well as the operational forecasts for error bar data, here is the category probabilistic forecast, the highlights of which are that we can now exclude a Near Normal season, and the chance of a Record Low season has surged: **Record High** (45 or more tropical cyclones): 0% (was 0% 20 days ago), **Far Above Normal** (38 to 44 tropical cyclones): 0% (was 0% 20 days ago), **Above Normal** (33 to 37 tropical cyclones): 0% (was 0% 20 days ago), **Near Normal** (29 to 32 tropical cyclones): 0% (was 2% 20 days ago), **Below Normal** (27 or 28 tropical cyclones): 2% (was 7% 20 days ago), **Far Below Normal** (21 to 26 tropical cyclones): 67% (was 73% 20 days ago), **Record Low** (20 or fewer tropical cyclones): 31% (was 18% 20 days ago)"

Tropical cyclone activity is normally reduced in the year that follows El Niño, and 2010 was no exception. The extreme reduction of the inactivity, however, was unusual, and follows a string of recent years (e.g., 2007 and 2008) with low activity. A recent posting (October 10, 2010) by Ryan Maue (<http://www.coaps.fsu.edu/~maue/tropical/>) details the unusual lack of global TC activity:

"Update: Current Year-to-Date [10 October 2010] analysis of Northern Hemisphere and Global Tropical Cyclone Accumulated Cyclone Energy (ACE) and Power Dissipation Index (PDI) has fallen even further than during the previous 3-years. The global activity is at 33-year lows and at a historical record low where Typhoons form in the Western Pacific. ...

While the North Atlantic has seen 15 tropical storms/hurricanes of various intensity, the Pacific basin as a whole is at historical lows! In the Western North Pacific stretching from Guam to Japan and the Philippines and China, the current ACE value of 58 is the lowest seen since reliable records became available (1945) and is 78% below normal. The next lowest was an ACE of 78 in 1998."

The tropical cyclone activity of the central and eastern North Pacific has also been exceptionally quiet during 2010. Through mid-October, there have been 12 numbered tropical cyclones in the eastern North Pacific. These include only seven named storms. There have been no numbered or named TCs in the central Pacific, and no eastern Pacific tropical cyclone has moved into the central Pacific from the eastern Pacific.

No heavily populated island has yet been severely affected by a typhoon. Some welcome rainfall has fallen recently on Guam and in the CNMI from the passage over those islands of the tropical disturbances that became typhoons Megi and Chaba. See the individual island summaries for more details on tropical cyclone threats.

PEAC Center Tropical Cyclone Outlook

The PEAC outlook¹ for tropical cyclones in the western North Pacific basin for the remainder of 2010 (November and December) is for low activity and continued westward displacement. The anticipated distribution of tropical cyclones for the remainder of 2010 reduces the risk of a damaging tropical storm or typhoon at all islands located eastward of 140°E. The risk of a damaging tropical cyclone at Yap or Palau (both located to the west of 140°E) will be close to normal. The upcoming hurricane season for American Samoa is also anticipated to be less active than normal (see island summaries for further details).

¹The PEAC tropical cyclone forecasts for 2010 are provisional. The PEAC considers input from three seasonal outlooks for tropical cyclone activity in the western North Pacific basin: (1) The City University of Hong Kong Laboratory for Atmospheric Research, under the direction of Dr. J. C-L. Chan; (2) The Benfield Hazard Research Centre, University College London, Tropical Storm Risk (TSR) research group, UK, led by Dr. Adam Lea and Professor Mark Saunders (<http://www.tropicalstormrisk.com>); and, (3) an experimental typhoon outlook produced by Paul Stanko (forecaster at the Guam WFO).

LOCAL SUMMARY AND FORECAST



American Samoa: Through the heart of its dry season (roughly June through October), American Samoa experienced gusty SE trade winds and slightly above normal rainfall. No extreme rainfall events or damaging weather conditions were reported.

American Samoa Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
Pago Pago WSO	Inches	8.30	4.32	9.68	22.30	19.55
	% Norm	132%	64%	145%	113%	100%
A'asufou	Inches	23.10	13.79	13.81	50.70	N/A
	% Norm	N/A	N/A	N/A	119%	N/A

¹ Predictions made in 2nd Quarter 2010 newsletter.

Climate Outlook: Computer forecasts and a consensus of outlooks from several regional meteorological centers indicate that rainfall in American Samoa is likely to be above normal for the next few months as the next rainy season becomes established. The rainy season and the hurricane season of 2010-2011 in the American Samoa region is about to begin. Anticipated atmospheric circulation anomalies associated with La Niña will favor enhanced tropical cyclone activity to the west of the region of American Samoa. Recent seasonal forecasts from the Bureau of Meteorology for the Australian region have called for a very active season in Australian waters. High activity is expected in all Australian TC regions including the Coral Sea. This typical La Niña pattern should keep most TC activity to the west of American Samoa. The threat of a direct strike by a hurricane at some location within American Samoa (normally on the order of 15-20%), will be reduced to 10% or less (but not zero!).

Predicted rainfall for American Samoa from Oct 2010 through Sep 2011 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²
Oct - Dec 2010 (Onset of Rainy Season)	120% (41.50 inches - Pago Pago)
January - March 2011 (Heart of Next Rainy Season)	120%
April - May 2011 (Onset of Next Dry Season)	100%
June - October 2011 (Heart of Next Dry Season)	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Guam/CNMI: Tranquil conditions dominated the weather of Guam and the CNMI for the 3rd Quarter of 2010. Easterly low-level wind anomalies associated with La Niña prevented the southwest monsoon from reaching the is-

LOCAL SUMMARY AND FORECAST

lands, and in doing so prevented tropical cyclones. On Guam, most areas were drier than normal, with a notable reduction of heavy rainfall events (i.e., more than 2 inches in 24 hours). Only two events of 3-4 inches in 24 hours, both of which occurred during October 2010, produced sufficient runoff in Guam's southern streams to generate extensive red plumes of sediment into the ocean. With the exception of the El Niño year of 2009, the past several years have seen no strong episodes of the SW monsoon, no typhoons, and few notable extremes of rainfall throughout Guam and the CNMI. On Guam, there have been two deaths this year from trees falling on people during fair weather. This is a sad irony, as during the active tropical cyclone seasons of the 1990s and early 2000s, there were no deaths on Guam attributed to falling trees or other wind-blown debris. In the CNMI, rainfall was near normal during the third quarter of 2010. Tranquil weather has dominated, and the monsoon and tropical cyclone activity has been conspicuously absent.

Guam and CNMI Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
Guam						
GIA (WFO)	Inches	12.09	12.18	12.15	36.42	36.04
	% Norm	115%	89%	90%	96%	95%
AAFB	Inches	8.56	9.32	11.50	29.38	35.78
	% Norm	78%	69%	86%	78%	95%
University of Guam	Inches	8.21	8.95	10.71	27.87	35.78
	% Norm	78%	65%	79%	74%	95%
Ugum Watershed	Inches	5.71	9.82	12.17	27.70	39.28
	% Norm	48%	67%	81%	67%	95%
Ypapao (Dededo)	Inches	9.07	9.97	10.60	29.64	35.64
	% Norm	83%	74%	80%	79%	95%
Sinajaña	Inches	12.50	9.70	15.19	37.39	35.88
	% Norm	118%	71%	113%	99%	95%
CNMI						
Saipan Intl. Airport	Inches	8.84	14.16	7.27	30.27	30.61
	% Norm	109%	113%	54%	89%	90%
Capitol Hill	Inches	9.44	16.16	10.61	36.21	31.64
	% Norm	105%	129%	79%	103%	90%
Tinian Airport	Inches	10.35	12.45	10.71	33.51	31.42
	% Norm	115%	100%	79%	96%	90%
Rota Airport	Inches	6.28	9.14	15.81	31.23	35.32
	% Norm	60%	69%	118%	84%	95%

¹ Predictions made in 2nd Quarter 2010 newsletter.

LOCAL SUMMARY AND FORECAST

Climate Outlook: For the remainder of 2010 and into February of 2011, Guam and the CNMI face a reduced risk of tropical cyclones passing within 200 miles of any Guam or CNMI location. La Niña reduces the risk of a damaging typhoon on Guam and in the CNMI, particularly when La Niña conditions develop rapidly after an El Niño year. The risk of a typhoon on Guam and in the CNMI is now less than 10% over the course of the next 3 months. (Low, but not zero!)

Rainfall is anticipated to be near normal for Guam and the CNMI for the remainder of 2010. During the first half of 2011, rainfall is anticipated to continue to be at, or slightly above normal.

Predicted rainfall for the Mariana Islands from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²	
	Guam/Rota	Saipan/Tinian
Oct – Dec 2010 (End of Rainy Season)	100% (25.63 Inches)	100% (22.06 inches)
Jan – March 2011 (Onset of next Dry Season)	100%	100%
Apr – June 2011 (2nd half of next Dry Season)	110%	110%
July - September 2011 (Next Rainy Season)	110%	110%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

**Federated States of Micronesia:**

Yap State: In the uneventful weather patterns of 2010, the rainfall across Yap State has been mostly near normal. For the three-month period of July through September, the rainfall across Yap Island was approximately 35 to 45 inches. WSO Yap received a three-month total of 44.63 inches, which was 103% of normal.

Climate Outlook: There is a slight risk (roughly a 5-10% chance) of a damaging tropical cyclone in Yap State or its outer atolls in November 2010 through January 2011. This level of risk is near normal. Most late season tropical cyclones affecting Yap form near Chuuk or Guam and pass to the north of Yap Island.

It is now expected that the upcoming dry season will be near normal throughout Yap State, both in terms of monthly rainfall and the duration of the dry season. No unusual dry periods are anticipated for the next three to six months.

LOCAL SUMMARY AND FORECAST

Yap State Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predict-ed ¹
Yap Island						
Yap WSO	Inches	17.73	16.83	10.07	44.63	41.16
	% Norm	122%	111%	75%	103%	95%
Dugor	Inches	15.27	17.51	8.99	41.77	41.16
	% WSO	105%	115%	67%	97%	95%
Gilman	Inches	13.54	15.12	10.24	38.90	41.16
	% WSO	93%	100%	76%	90%	95%
Luweech	Inches	16.44	17.97	11.93	46.34	41.16
	% WSO	113%	119%	89%	107%	95%
Maap	Inches	14.20	14.24	6.54	34.98	41.16
	% WSO	98%	94%	49%	81%	95%
North Fanif	Inches	14.83	14.23	10.60	39.66	41.16
	% WSO	102%	94%	79%	92%	95%
Rumung	Inches	12.82	13.64	11.48	37.94	41.16
	% WSO	88%	90%	86%	88%	95%
Tamil	Inches	12.37	11.38	8.68	32.43	41.16
	% WSO	85%	75%	65%	75%	95%
Outer Islands						
Ulithi	Inches	10.35	12.45	10.71	33.51	34.98
	% Norm	84%	96%	93%	91%	95%
Woleai	Inches	6.28	9.14	15.81	31.23	27.47
	% Norm	63%	95%	170%	108%	95%

¹ Predictions made in 2nd Quarter 2010 newsletter.

Predicted rainfall for Yap State from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²	
	Yap and Ulithi	Woleai
October – December 2010 (End of Rainy Season)	110% (33.45 inches)	100% (35.86 inches)
January – April 2011 (Next Dry Season)	100%	100%
May – June 2011 (Onset of Next Rainy Season)	120%	100%
July – September 2011 (Heart of Next Rainy Season)	110%	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

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LOCAL SUMMARY AND FORECAST

Chuuk State: Rainfall was abundant throughout Chuuk State during the 3rd Quarter of 2010, with some large month-to-month and island-to-island variations. The 3rd quarter total of 50.38 inches (132%) of rain at the Chuuk WSO was one of the highest values reported in Micronesia, in terms of magnitude and percent of normal (See Figs 1a and 1b, page 2). The Chuuk WSO (in the lagoon) and Piis Panew (on the rim of the Lagoon) experienced over 20 inches of rain during August 2010. Rain in excess of 20 inches in one month is not that rare in Chuuk, and occurs on average roughly once or twice per year. Monthly rainfall exceeding 20 inches is most common in August and September, and it has not historically occurred in February or March at the WSO. The month of September was drier than July or August at all Chuuk locations. Polowat was the driest location, with a July through September rainfall of less than 20 inches (46%).

Chuuk State Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
Southern Mortlocks						
Lukunoch	Inches	20.21	15.30	12.98	48.49	38.18
	% WSO	167%	105%	113%	127%	100%
Ettal	Inches	19.28	15.62	16.94	51.84	38.18
	% WSO	159%	107%	142%	136%	100%
Ta	Inches	12.60	17.81	7.10	37.51	38.18
	% WSO	104%	122%	62%	98%	100%
Namoluk	Inches	13.94	12.72	10.84	37.50	38.18
	% WSO	115%	87%	94%	98%	100%
Northern Atolls						
Fananu	Inches	13.28	14.20	5.20	32.68	34.35
	% WSO	110%	97%	45%	86%	90%
Onoun	Inches	11.92	16.76	14.59	43.27	34.35
	% WSO	99%	115%	127%	113%	90%
Northern Mortlocks						
Losap	Inches	10.25	10.31	12.21	32.77	34.35
	% WSO	85%	71%	106%	86%	90%
Nama	Inches	11.44	9.53	7.94	28.91	34.35
	% WSO	95%	65%	69%	76%	90%
Western Atolls						
Polowat	Inches	8.59	8.51	2.51	19.61	36.26
	% WSO	61%	57%	19%	46%	95%
Chuuk Lagoon						
Chuuk WSO	Inches	14.63	22.64	13.11	50.38	34.35
	% Norm	121%	155%	114%	132%	90%
Piis Panew	Inches	14.00	21.05	3.08	38.13	34.35
	% WSO	116%	144%	27%	100%	90%

¹ Predictions made in 2nd Quarter 2010 newsletter.

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Climate Outlook: Northern Chuuk State will soon enter its short dry season, in which the months of February and March typically fall below 10 inches of rain. It is anticipated that near normal rainfall will be experienced in Chuuk State for the next 3 to 6 months. With an active and persistent trade wind trough developing in the spring of 2011, the Mortlock Islands should be wetter during this time (April through June) than other islands and atolls further to the north.

For the next three months (November 2010 through January 2011), there is a low risk chance (1-in-10, or 10%) of a tropical storm passing through Chuuk State. One or two episodes of heavy rain and gusty westerly winds may occur through December, after which time northeast winds and typical dry season weather conditions should prevail.

With sea level above normal during the next 3 to 6 months, there is an elevated risk of sea inundation during times of highest surf. This inundation will likely occur in areas where large winter surf caused problems in recent years.

Predictions for Chuuk State from October 2010 through September 2011 are as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²			
	Chuuk Lagoon, Northern Mortlocks	Polowat	Northern Atolls	Southern Mortlocks
Oct – Dec 2010	100% (35.55 inches)	90% (32.0 in)	95% (33.77 in)	100% (35.55 in)
Jan – Mar 2011	100%	90%	90%	100%
Apr – June 2011	110%	100%	100%	130%
Jul – Sep 2011	100%	100%	100%	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

Pohnpei State: The 3rd Quarter rainfall was slightly drier than normal on Pohnpei Island and on most atolls of Pohnpei State. Because La Niña has produced colder than normal sea surface temperature along the equator, the atolls of Pohnpei State that are located at low latitudes (e.g., Kapingamarangi at 1°N and Nukuoro at 4°N) have had reduced rainfall in recent months. The reduction of rainfall has been most pronounced at Kapingamarangi where only 0.72 inches of rain (12%) fell in September 2010. This level of dryness has prompted the WFO Guam in coordination with the WSO Pohnpei to issue weekly drought advisories for Kapingamarangi, which will continue until rainfall resumes at that island. Rainfall is expected to remain low at Kapingamarangi for the next few months, but then recover somewhat as the southern Hemisphere summer wind patterns become established in January 2011.

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Pohnpei State Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
Pohnpei Island						
Pohnpei WSO	Inches	14.00	14.23	15.00	43.23	50.98
	% Norm	76%	86%	93%	85%	100%
Palikir	Inches	11.96	18.02	10.98	40.96	54.76
	% Norm	61%	101%	64%	75%	100%
Kolonia Airport	Inches	9.93	12.24	13.64	35.81	41.64
	% Norm	66%	90%	104%	86%	100%
Atolls of Pohnpei State						
Nukuoro	Inches	16.92	13.39	4.43	34.74	36.75
	% Norm	118%	118%	40%	95%	100%
Pingelap	Inches	9.08	10.22	11.89	31.19	45.87
	% Norm	57%	69%	79%	68%	100%
Mwoakil-loa	Inches	8.83	15.94	13.27	38.04	41.80
	% WSO	59%	118%	101%	91%	100%
Kapingamarangi	Inches	4.51	3.16	0.72	8.39	22.48
	% Norm	43%	51%	12%	37%	100%

¹ Predictions made in 2nd Quarter 2010 newsletter.

Climate Outlook: For the next three months (November 2010 through January 2011), the dry conditions at Kapingamarangi should continue. After the Southern Hemisphere summer wind patterns become established in January, the rainfall at Kapingamarangi will gradually recover to near normal.

Pohnpei Island usually experiences its heaviest monthly rainfall during April through June. It may be quite wet on Pohnpei Island during April through June of 2011, with 25-30 inches of rain possible in one of those months at the WSO or at Palikir. A direct strike of any Pohnpei State location by a tropical storm or typhoon is not anticipated in the foreseeable future.

Predicted rainfall for Pohnpei State from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²	
	Pohnpei Island and atolls	Kapingamarangi
Oct - Dec 2010	90% (42.91 inches)	50% (10.88 inches)
Jan - Mar 2011	95%	75%
Apr - Jun 2011	120%	90%
Jul - Sep 2011	100%	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

LOCAL SUMMARY AND FORECAST

Kosrae State: The tongue of colder-than-normal sea surface temperatures, which is responsible for the substantial reduction of the rainfall at Kapingamarangi, has had a small but noticeable impact on rainfall at Kosrae. Located at just under 6°N, the island of Kosrae has, at times, been in dry easterly wind flow, with heavier rainfall passing to the north in the convergence zone. Conditions across Kosrae were particularly dry in September, with the 3-month period of July through September receiving only about 75% of normal rainfall.

Kosrae State Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
Airport (SAWRS)	Inches	18.69	10.55	6.94	36.18	50.70
	% Norm	110%	64%	40%	71%	100%
Utwā	Inches	21.44	15.21	9.89	46.54	50.70
	% WSO	126%	92%	58%	92%	100%
Nautilus Hotel	Inches	16.74	12.25	7.83	36.82	50.70
	% WSO	98%	74%	46%	73%	100%
Tofol	Inches	17.83	12.07	8.97	38.87	50.70
	% WSO	105%	73%	52%	77%	100%

¹ Predictions made in 2nd Quarter 2010 newsletter.

Climate Outlook: Monthly rainfall amounts should fall slightly short of normal for the next 2 or 3 months, thereafter returning to near normal. When the convergence zone (i.e., ITCZ) rainfall returns in April and May 2011, it should be slightly wetter than normal on Kosrae.

Predicted rainfall for Kosrae State from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²
October – December 2010	90% (41.94 inches)
January – March 2011	95%
April – June 2011	120%
July - September 2011	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Republic of Palau: Tranquil weather prevailed throughout the Republic of Palau during the 3rd Quarter of 2010. An unusual abundance of easterly low-level winds related to La Niña contributed to fewer heavy rainfall events. This is attributed to tropical cyclones passing to the north, and a lack of heavy rainfall normally associated with the monsoon trough. La Niña usually makes Palau wetter than normal, but this La Niña has forced rain-making systems farther to the west and north.

LOCAL SUMMARY AND FORECAST

Republic of Palau Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
WSO Koror	Inches	10.54	12.81	11.95	35.30	44.85
	% Norm	58%	86%	101%	79%	100%
Nekken	Inches	13.52	N/A	7.70	N/A	44.85
	% WSO	75%	N/A	65%	N/A	100%
Intl. Airport	Inches	12.75	15.00	9.54	37.29	44.85
	% WSO	71%	100%	80%	83%	100%
Peleliu	Inches	10.86	12.67	11.55	35.08	44.85
	% WSO	61%	85%	97%	79%	100%

¹ Predictions made in 2nd Quarter 2010 newsletter.

Climate Outlook: There is only a slight risk (5% or less) of a damaging tropical cyclone in the Republic of Palau in November or December of 2010. It is more likely that one of the basin's final typhoons of 2010 will move to the north or northeast of Palau to bring a few days of gusty westerly winds and some heavy showers.

With La Niña conditions soon reaching a peak, and then slowly abating during the first half of 2011, Palau should have near-normal to above-normal rainfall for the foreseeable future.

Predicted rainfall for Palau from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²
October – December 2010	100% (37.36 inches)
January – March 2011	100%
April – June 2011	120%
July – October 2011	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Republic of the Marshall Islands (RMI):

It has been drier than normal much of the time during the past several years throughout the RMI. During the 3rd Quarter of 2010, rainfall continued to be below normal at most RMI locations. For example, Kwajalein had a 3rd Quarter total of 22.82 inches that was only 70% of normal. One notable exception to the generally observed below-normal rainfall across the RMI occurred at Majuro, where the 3rd Quarter was very wet. The 49.70 inches of rain at Majuro during the 3rd Quarter was 135% of normal. In fact, consistent high rainfall over the past six months has already pushed Majuro beyond its normal annual rainfall with two months left to go in the year! This welcome spell of heavier rainfall may be attributed to a favorable setup of the trade-wind

LOCAL SUMMARY AND FORECAST

trough (or ITCZ) in the low levels of the atmosphere, coupled with a favorable positioning of the upper-level flow pattern, and to some extent Majuro's location under heavier showers passing westward in the ITCZ. Just to the east of the Majuro Atoll, the rainfall at Arno for the 3rd Quarter was 34.20 inches, or 93% of normal. Recently, a big rain event did occur at Kwajalein on the 17th and 18th of October 2010, with a total of 8.56 inches of rain reported over those two days. This pushed the October 2010 total to over 15 inches. Kwajalein has not had over 15 inches of rain in a month since October 2006.

RMI Rainfall Summary 3rd Qtr 2010						
Station		Jul.	Aug.	Sep.	3rd Qtr	Predicted ¹
RMI Central Atolls (6° N - 8° N)						
Majuro WSO	Inches	15.76	14.09	19.58	49.70	36.32
	% Norm	121%	122%	160%	135%	100%
Laura	Inches	8.02	N/A	14.56	N/A	36.32
	% Norm	62%	N/A	117%	N/A	100%
Aling-laplap	Inches	3.15	14.52	16.38	34.05	36.32
	% Norm	27%	134%	135%	98%	100%
Arno	Inches	10.46	11.29	12.45	34.20	36.32
	% Norm	80%	90%	100%	93%	100%
RMI Southern Atolls (South of 6° N)						
Jaluit	Inches	13.71	4.39	8.95	27.05	36.32
	% Norm	105%	38%	72%	73%	100%
RMI Northern Atolls (North of 8° N)						
Kwajalein	Inches	7.14	7.33	8.35	22.82	30.76
	% Norm	68%	73%	71%	70%	95%
Wotje	Inches	3.25	9.48	9.12	21.85	30.76
	% Norm	33%	99%	98%	76%	95%
Utirik	Inches	N/A	N/A	N/A	N/A	30.76
	% Norm	N/A	N/A	N/A	N/A	95%

¹ Predictions made in 2nd Quarter 2010 newsletter.

Climate Outlook: The rainy season in the RMI extends through December. Abundant rainfall should continue there through the end of the year. Looking ahead, near-normal rainfall is anticipated through the RMI dry season of 2011. This is a break from recent years in which the dry season has seen reduced rainfall at many RMI locations. Similar to many locations in the Hawaiian Islands, the atolls of the RMI have statistically significant long-term trends toward reduced rainfall over their 60-year period of climate observational records. This trend would lead one to be pessimistic that the abundant rainfall of 2010

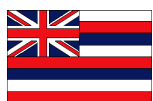
LOCAL SUMMARY AND FORECAST

would continue into 2011, but we are optimistic that at least near-normal rainfall will fall in the RMI through the dry season of 2011, albeit with the strong normal north-south gradient that gives the central atolls (e.g., Majuro) more rain, and the northern atolls (e.g., Kwajalein) less rain.

Predicted rainfall for the RMI from October 2010 through September 2011 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) ²		
	South of 6°N	6°N to 8°N	North of 8°N
Oct – Dec 2010 (End of Rains)	110% (41.85 inches)	120% (45.65 in)	120% (36.17 in)
Jan – March 2011 (Dry Season)	100%	100%	95%
April – June 2011 (Onset of Rains)	120%	100%	95%
July – Sept 2011 (Rainy Season)	100%	110%	100%

² Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Hawaii: Persistent trade winds throughout August and September 2010 have provided sufficient rainfall for windward areas of the Hawaiian Islands. However, most leeward areas statewide remained very dry. Exceptional drought, or D4 category on the U.S. drought monitor map, continued in the South Kohala district and the southeast portion of the Kau district on the Big Island. Pasture and general vegetation conditions have remained poor on Lanai, Maui, and on the leeward portion of the Big Island. Extreme drought conditions are still present in most of Maui County, the eastern end of Oahu, and the east and southeast slopes of Kauai. This drought state in Hawaii has led to increased deterioration of pastures in Kauai, Lanai, and Maui and a 30% cut-back in irrigation water use in Oahu and Molokai. Effects from the exceptional drought on the Big Island include a declining population of the endangered Palila bird, and ranchers hauling water for livestock sustenance.

Over the past 12 months, the ongoing drought has significantly affected a wide range of agricultural products, including cattle, coffee, avocados, rambutan, bananas, corn, macadamia nuts, loquat, and jaboticaba. Only drought-resistant trees and crops have managed to produce well.

End-of-the-month rainfall in September 2010 bettered conditions in the Kona district and filled water catchments. This has improved the growing conditions in the coffee belt, but overall rainfall is still below normal. Additionally, rainfall has been above average along the Koolau Range on Oahu.

LOCAL SUMMARY AND FORECAST

Hilo and Kapapala Ranch remain on pace for the driest year on record, with Hilo rainfall at 37.05 inches through September. The normal there is over 90 inches. The record for the driest year at Hilo is 68.09 inches from 1983. Kapapala Ranch is at 5.41 inches through September, and the normal is 42 inches. Kapapala Ranch's record is 13.42 inches from 1998.

State of Hawaii Rainfall Summary 3rd Qtr 2010					
Station		July	Aug.	Sep.	3rd Qtr
Lihue Airport	Inches	1.12	1.32	1.33	3.77
	% Norm	53%	69%	49%	56%
Honolulu Airport	Inches	0.38	0.14	0.63	1.15
	% Norm	76%	30%	85%	68%
Kahului Airport	Inches	0.08	0.07	0.21	0.36
	% Norm	16%	13%	54%	26%
Hilo Airport	Inches	3.98	4.31	2.75	11.04
	% Norm	37%	44%	30%	37%

Climate Outlook: The US Climate Prediction Center (CPC) indicates that La Niña will be a primary influence in the drier-than-normal condition predicted through November of 2010. It is then predicted to become wetter than normal from January to April/May of 2011. It should be noted however, that there is more uncertainty in this forecast as compared to last years forecast involving El Niño conditions.

Previous wet seasons with a moderate to strong La Niña are 1999, 2000, and 2008. Conditions that have been associated with these previous seasons include: higher-than-normal frequency of trade winds, occasional upper-level lows producing heavy rains, wet conditions primarily affecting windward areas, and leeward areas remaining dry in the 1999 and 2000 events.

Drought recovery is more likely on smaller islands (Kauai to Molokai) and over windward slopes of the Big Island and Maui.

The possibility of drought continues through the wet season, especially over leeward areas, if conditions remain similar to 1999 and 2000.

The next long-lead forecast will be issued on October 21, 2010.

**For more information on weather and climate
in Hawaii go to**

<http://www.prh.noaa.gov/pr/hnl/>

or

www.cpc.noaa.gov/products/predictions/long_range/fxhw40.html

4th Quarter, 2010

Seasonal Sea-Level Outlook for the US-Affiliated Pacific Islands

The following sections describe: (i) the *Canonical Correlation Analysis (CCA)* forecasts for seasonal (mean and maxima) sea-level deviations for the forthcoming seasons OND, NDJ, and DJF of 2010-2011; (ii) the observed monthly mean and maximum sea-level deviations for the season JAS 2010; (iii) forecast verifications for JAS 2010 (observed/forecast values). *Note that the deviations are defined here as ‘the difference between the mean sea level for the given month and the 1975 through 1995 mean sea level value computed at each station’.* Also note that, the CCA-forecasting technique adapted here does not account for sea-level deviations created by other atmospheric or geological factors such as tropical cyclones, storm surges or tsunamis.

(i) **Seasonal sea level forecast** (deviations with respect to climatology) for OND, NDJ, and DJF of 2010.

Table 1: Forecasts of sea-level deviation (in inches) for OND, NDJ, and DJF 2010-2011.

Tide Gauge Station	Seasonal Mean Deviations ¹				Seasonal Max Deviations ²					
	OND	NDJ	DJF	Forecast Quality ³	OND	NDJ	DJF	Forecast Quality ³	Return Period ⁴ for OND Season	
Lead Time ⁵	0	1M	2M		0	1M	2M		20 Year	100 Year
Marianas, Guam	+7	+8	+8	V. Good	+22	+22	+22	Good	6.5	9.1
Malakal, Palau	+8	+7	+6	V. Good	+45	+45	+45	Good	6.1	6.4
Yap, FSM	+7	+6	+5	V. Good	+35	+35	+35	Good	8.2	11.0
Chuuk, FSM**	+7	+5	+5	N/A	+35	+35	+33	N/A	N/A	N/A
Pohnpei, FSM	+9	+9	+8	V. Good	+40	+33	+33	Good	9.1	11.8
Kapingamarangi, FSM	+5	+6	+6	Good	+32	+24	+24	Fair	5.7	6.4
Majuro, RMI	+7	+6	+5	V. Good	+48	+45	+45	Good	6.6	8.4
Kwajalein, RMI	+6	+5	+5	V. Good	+44	+45	+45	V. Good	4.9	6.1
Pago Pago, Am. Samoa	+3	+3	+4	Good	+28	+32	+32	Good	3.0	3.7
Honolulu, Hawaii	+1	0	-3	Fair	+22	+22	+23	Fair	3.2	5.2
Hilo, Hawaii	+1	0	-1	Good	+40	+40	+39	Good	5.5	6.8

Remarks: The forecast values of sea level for OND, NDJ, and DJF seasons (Table 1, above), indicate that sea levels for most of the stations in the north Pacific are likely to record further rise in the forthcoming seasons. The maxima will also be higher than normal during the same time period. This will be due to prevailing stronger-than-average westerly wind anomalies in the vicinity of western and central tropical Pacific. The Hawaiian stations, on the other hand, are likely to be close to normal during the same time period. The forecasted values are supportive of moderate La Niña conditions, which have recently strengthened in August, 2010.

Note: (-) indicate negative deviations (fall of sea-level from the mean), and (+) indicate positive deviations (rise of sea-level from the mean), N/A: data not available; also note that any deviations from -1 to +1 inches are considered negligible and deviations from -2 to +2 inches are unlikely to cause any adverse climatic impact. Forecasts for Chuuk (**) are estimated subjectively based on information from WSO Chuuk and observations from neighboring stations of Pohnpei and Yap.

(1) **Seasonal Mean Deviation** is defined as the difference between the mean sea level for the given month and the 1975-1995 mean sea level value at each station. Likewise, (2) **Seasonal Maximum Deviation** is defined as the difference of the maximum sea level (calculated from hourly data) for the given month and the 1975-1995 mean sea level value at each station.

(3) **Forecast Quality** is a measure of the expected CCA cross-validation correlation skill. In general terms, these forecasts are thought to be of useful (but poor) skill if the CCA cross-validation value lies between 0.3 ~ 0.4 (Fig. 3). Higher skills correspond to a greater expected accuracy of the forecasts. Skill levels greater than 0.4 and 0.6 are thought to be fair and good, respectively, while skill levels greater than 0.7 are thought to be very good.

(4) **Return Period (RP)** of extreme values is calculated from hourly sea-level data. For example, the predicted rise of 6.5 inches at 20-year RP at Marianas, Guam indicates that this station may experience an extreme tide event once every 20 years that could result in sea level rise of up to 6.5 inches above the median of seasonal maxima during the OND season. Likewise, about once every 100 years we can expect the highest OND tide at Marianas, Guam to be as high as 9.1 inches above the median of seasonal maxima. During some seasons some stations display alarmingly high values at the 20 and 100 year RP. These high values are due to large and significant increases in the tidal range caused by the passage of past storm events during that season.

(5) **Lead Time** is the time interval between the end of the initial period and the beginning of the forecast period. For example, lead-0, lead-1M, and lead-2M means ‘sea level’ of target season 0 (OND), 1 (NDJ), and 2 (DJF) month leads based on SSTs of JAS 2010.

Seasonal Sea-Level Outlook for the US-Affiliated Pacific Islands

(ii) Observed Monthly Sea Level Deviation in July-August-September (JAS) 2010

The monthly time series (JAS) for sea-level deviations have been taken from the UH Sea Level Center. The full time series (in mm) for monthly mean is available at: <ftp://ilikai.soest.hawaii.edu/islp/slpp.deviations>. Locations of all these stations are shown in Fig 2. The

Table 2 : Monthly observed max/mean sea level deviations in inches (year-to-year standard deviation in parentheses)

Tide Gauge Station	Monthly Mean Deviations ¹				Monthly Max Deviations ²			
	July	Aug.	Sept.	Standard Deviations	July	Aug.	Sept.	Standard Deviations
Marianas, Guam	+6.6	+6.6	+6.4	3.3	+22.3	+19.2	+22.2	3.4
Malakal, Palau	+10.6	+10.5	+7.8	4.1	+47.5	+47.5	+44.7	4.3
Yap, FSM	+6.4	+6.4	+6.4	4.4	+32.2	+34.9	+34.9	4.0
Chuuk, FSM**	*	*	*	(*)	*	*	*	(*)
Pohnpei, FSM	+4.1	+3.6	*	2.8	+32.1	+31.4	*	3.3
Kapingamarangi, FSM	*	*	*	2.4	*	*	*	2.6
Majuro, RMI	+2.4	+3.6	*	2.3	+42.0	+45.4	*	3.0
Kwajalein, RMI	+3.9	+3.8	+4.2	2.2	+41.8	+42.9	+44.6	2.8
Pago Pago, American Samoa	+6.6	+5.5	+5.6	2.8	+30.9	+29.7	+22.2	3.3
Honolulu, Hawaii	+2.8	+2.7	+3.6	1.9	+23.9	+22.9	+22.2	2.3
Hilo, Hawaii	+1.7	+2.7	+3.9	1.8	+23.8	+25.1	+26.4	2.4

Remarks: As compared to August 2010, the monthly mean sea-level in September 2010 didn't change much. It remained mostly steady in most of the stations. However, Malakal recorded a fall after three months of recorded high sea level. The monthly maxima also displayed similar trends (mostly steady) in most stations, except Guam where it recorded a rise. Again in Palau, the maximum sea level recorded a fall.

The current trend of sea level, which is 2-6 inches higher than normal in the vicinity of the western Pacific, is supportive of an ongoing La Niña condition. According to CPC, La Niña is expected to strengthen and last through Northern Hemisphere winter 2010-11. Enhanced low-level easterly trade winds and anomalous upper-level westerly winds continued over the western and central equatorial Pacific. Collectively, these oceanic and atmospheric anomalies reflect the development and strengthening of La Niña conditions.

(iii) Forecast Verification (Seasonal Mean) for JAS 2010

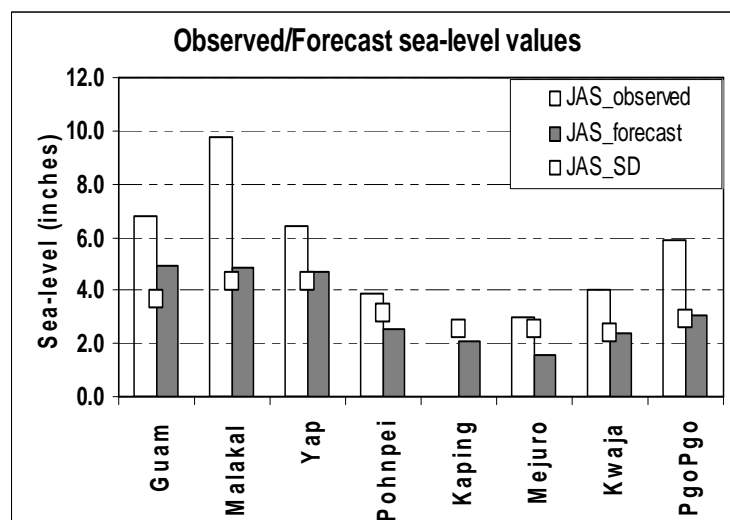


Figure 3: The observed and forecasted values for the previous season JAS is presented above. Forecasts were in general skillful; however, Malakal and Pago Pago were under forecasted.

Tide Gauge Stations

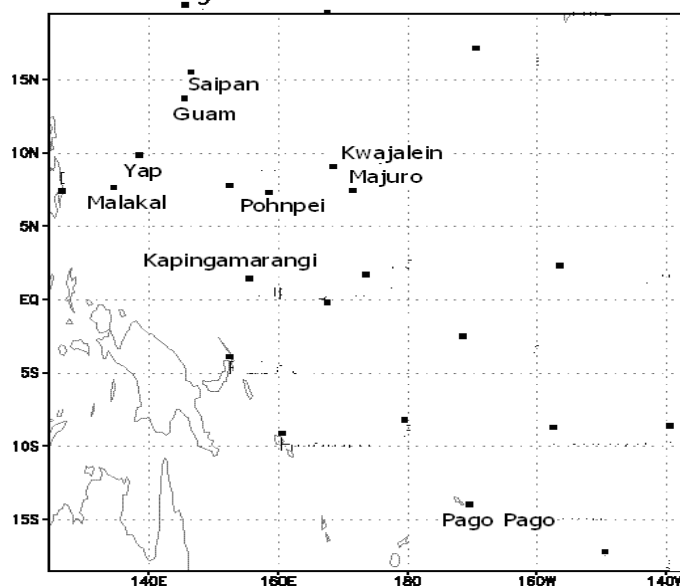


Figure 2: Locations of USAPI tide gauge stations.

Pacific ENSO Update

Excerpts from El Niño/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

Issued by NOAA NWS Climate Prediction Center - 7 October 2010

http://www.cpc.noaa.gov/products/analysis_monitoring/enso_advisory/index.shtml

ENSO Alert System Status: **La Niña Advisory**

Synopsis: La Niña is expected to last at least into the Northern Hemisphere spring 2011.

La Niña continued during September 2010 as reflected by the large expanse of below-average sea surface temperatures (SSTs) across most of the equatorial Pacific Ocean. All weekly Niño SST index values were between -1.3°C and -1.8°C at the end of the month. In addition, the subsurface heat content (average temperatures in the upper 300m of the ocean) remained below-average, reflecting a shallower-than-average thermocline in the central and eastern Pacific. Convection remained enhanced over Indonesia and suppressed over the western and central equatorial Pacific. This pattern was linked to a continuation of enhanced low-level easterly trade winds and anomalous upper-level westerly winds over the western and central equatorial Pacific. Collectively, these oceanic and atmospheric anomalies reflect the ongoing La Niña.

Consistent with nearly all of the forecast models, La Niña is expected to last at least into the Northern Hemisphere spring 2011. Just over half of the models, as well as the dynamical and statistical averages, predict La Niña to become a strong episode (defined by a 3-month average Niño-3.4 index of -1.5°C or colder) by the November-January season before beginning to weaken. Even though the rate of anomalous cooling temporarily abated during September, this model outcome is favored due to the historical tendency for La Niña to strengthen as winter approaches.

Likely La Niña impacts during October-December 2010 include suppressed convection over the central tropical Pacific Ocean, and enhanced convection over Indonesia. The transition into the Northern Hemisphere fall means that La Niña will begin to exert an increasing influence on the weather and climate of the United States. Expected U.S. impacts include an enhanced chance of above-average precipitation in the Pacific Northwest, and below-average precipitation across the southern tier of the country. Also, La Niña can contribute to increased Atlantic hurricane activity by decreasing the vertical wind shear over the Caribbean Sea and tropical Atlantic Ocean (see the August 5th update of the NOAA Atlantic Seasonal Hurricane Outlook). Conversely, La Niña is associated with suppressed hurricane activity across the central and eastern tropical North Pacific.

The Pacific ENSO Update is a bulletin of the Pacific El Niño-Southern Oscillation (ENSO) Applications Climate (PEAC) Center. PEAC conducts research & produces information products on climate variability related to the ENSO climate cycle in the U.S.-Affiliated Pacific Islands (USAPI). This bulletin is intended to supply information for the benefit of those involved in such climate-sensitive sectors as civil defense, resource management, and developmental planning in the various jurisdictions of the USAPI.

The Pacific ENSO Update is produced quarterly both online and in hard copy, with additional special reports on important changes in ENSO conditions as needed. For more information about this issue please contact the editor at peac@noaa.gov or at the address listed below.

PEAC is part of the Weather Forecast Office (WFO) Honolulu's mission and roles/responsibilities. All oversight and direction for PEAC is provided by the Weather Forecast Office Honolulu in collaboration with the Joint Institute for Marine and Atmospheric Research (JIMAR) at the University of Hawai'i. Publication of the Pacific ENSO Update is supported by the National Oceanic and Atmospheric Administration (NOAA), National Weather Service-Pacific Region Climate Services. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA, any of its sub-agencies, or cooperating organizations.

ACKNOWLEDGEMENTS AND FURTHER INFORMATION

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